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SHORT COMMUNICATION

EVALUATION OF QUALITY LOSS IN A FISH BASED, READY-TO-EAT FOOD (FISH ROLL) DURING REFRIGERATED STORAGE

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ABSTRACT

In this study, samples of commercially sold fish roll snacks, were kept for 30days in refrigerated storage at 4°C and subjected to biochemical evaluation. Biochemical parameters showed a rising trend in pH, peroxide value, free fatty acid with trimethylamine (TMA) values increasing significantly during storage. Results of biochemical analyses indicated that the fish roll samples were still fit for consumption at the end of the experiment.

KEYWORDS: Fish rolls, trimethylamine, peroxide value, free fatty acid, pH

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INTRODUCTION

Fish is a highly nutritious food and it is particularly valued for its protein which is of high quality compared to those of meat and egg (Ojutiku *et al*., 2009). It contains high quality protein, amino acids and absorbable dietary minerals (Bruhiyan *et al.*, 1993).

In recent years, the increase of the world population as well as various socio-economic changes has been directed towards the fast food consumption due to rapid urbanization and increase in working women population. Nowadays, due to advancing technology, seafood products are being ready-to-consume by processing and packaging in various ways like other foodstuff. This situation offers both innovation and taste and provides consumption of delicious and nutritive foodstuff by less time and energy (Varlik *et al*., 2000).Processing of aquatic products e.g. fish into value added products, also enhances their acceptability and market value. Value addition means employing processing methods, specialized ingredients or novel packaging to enhance the nutrition, sensory characteristics, shelf life and convenience of food products (Pagarkar *et al*., 2011).

Products such as fish cake, fish crackers, fish balls and fish burgers made from fish or other sea foods are of the most preferred ready-to-eat foods by consumers around the world and various studies have been conducted on the production, quality, and stability of these foods (Cakli *et al*., 2005).However, fish and fish products can undergo undesirable changes during processing and storage and deterioration may limit their shelf life. These undesirable changes result from protein denaturation and lipid oxidation (Siddaiah *et al*., 2001; Benjakul *et al*., 2005).Previous research has focused on the quality control of fish-based ready-to-eat products from different parts in the world, aiming especially at the microbial activity development and degree of safety (Oh *et al*., 2007; Meloni *et al*., 2009; Miya *et al*., 2010; Kim *et al.*, 2011).

However studies concerning the chemical changes, related to quality loss have been scarce and focused mainly on protein changes (smoked salmon product; Guillén-Casla *et al.*, 2011),volatile amine formation (refrigerated vacuum packaged octopus product; Mendes *et al.*,2011), lipid composition and oxidation (tilapia fish curry product; Dhanapal *et al.*, 2010) and nutraceutical compound addition (Braida and Gormley,2008).This study however, focused on the quality loss in a fish based ready-to-eat meal(fish roll) during its refrigerated storage at 4°C.In it, the quality changes in the fish roll samples relating to lipid damage (oxidation and hydrolysis) were analyzed.

MATERIALS AND METHODS

Sample collection

Samples of six different brands of fresh fish rolls (FR1, FR2, FR3, FR4, FR5, FR6)were purchased from six different kiosks in Lagos. At each site of purchase, samples of snacks (fish roll) were obtained from a vendor who was preparing the food snacks on site. The samples were aseptically collected in a clean polyethylene bag and transferred immediately to the laboratory for further analysis. Samples were collected in April, 2014.

Sample treatment

The fish roll samples were first oven dried at a temperature of 100ºC for 1 hour. After drying, the samples were milled into fine powder using a major blender. The samples were sieved and then stored in dry plastic bottles. They were then kept in a laboratory refrigerator for preservation pending analyses.

Sample analysis

Lipid Extraction: Lipids were extracted from the samples according to the Bligh and Dyer (1959) method, by employing a single-phase solubilization of the lipids using a chloroform-methanol (1:1) mixture. The pH was determined by taking 5g of ground sample and mixed with 45ml distilled water and then filtered using a filter paper. The pH of the filtrate was recorded using a pH meter (AOAC, 2005).The free fatty acid (FFA) content was determined in the lipid extract according to the Lowry and Tinsley (1976) method based on a complex formation with cupric acetate-pyridine followed by spectrophotometric (715nm) assessment. Results are expressed as g FFA $100g^{-1}$ lipids. The peroxide value (PV) was determined in the lipid extract by peroxide reduction with ferric cynanate according to Chapman and Mckay (1949) method. Results were expressed as meq active oxygen kg^{-1} lipids. The trimethylamine (TMA) content in the samples were determined by the micro-diffusion method of Conway (1968).

Statistical analysis: Data obtained were analyzed using SPSS (Statistical Package For Social Science) version 16.0 by one way analysis of variance (ANOVA) to assess the significance at $p<0.05$.The means of treatment showing significant differences ($p<0.05$) were subjected to Duncan's Multiple Range Test.

RESULTS

The results of the biochemical evaluation of the refrigerated fish roll samples are shown in Table 1.

Table 1: pH, Free Fatty Acid (FFA), Peroxide (PV) and Trimethylamine (TMA) values of the refrigerated fish roll samples at 4^{o}C.

Fish Roll 1	Storage period (Days)	pH	FFA(% of oleic acid)	PV(meqO_2/kg of fat)	TMA
	0	$6.6^{a} \pm 0.07$	$4.09^{a} \pm 0.03$	$8.78^{a} \pm 0.01$	$6.41^{a} \pm 0.01$
	10	$6.9^{a} \pm 0.01$	$5.09^{ab} \pm 0.09$	$9.94^{b} \pm 0.09$	$6.59^{ab} \pm 0.03$
	20	$7.1^{a} \pm 0.07$	$5.94^{b} \pm 0.07$	$11.48^{c} \pm 0.03$	$7.56^{b} \pm 0.03$
	30	$7.2^{a} \pm 0.01$	$6.97^{c} \pm 0.08$	$11.9^{c} \pm 0.14$	$7.85^{c} \pm 0.07$
Fish Roll 2	Days	pH	FFA	PV	TMA
	0	$6.2^{b} \pm 0.01$	$4.16^{d} \pm 0.01$	$7.69^{d} \pm 0.06$	$6.57^{d} \pm 0.02$
	10	$6.6^{b} \pm 0.01$	$4.48^{de} \pm 0.04$	$8.02^{e} \pm 0.03$	$6.98^{e} \pm 0.04$
	20	$7.0^{b} \pm 0.03$	$4.94^{e} \pm 0.04$	$8.53^{ef} \pm 0.04$	$7.01^{f} \pm 0.01$
	30	$7.5^{b} \pm 0.07$	$5.64^{f} \pm 0.06$	$9.16^{f} \pm 0.02$	$7.05^{g} \pm 0.03$
Fish Roll 3	Days	pH	FFA	PV	TMA
	0	$6.8^{c} \pm 0.04$	$3.49^{g} \pm 0.01$	$7.18^{g} \pm 0.04$	$6.4^{h} \pm 0.07$
	10	$7.1^{cd} \pm 0.01$	$3.99^{h} \pm 0.04$	$7.54^{gh} \pm 0.06$	$7.11^{i} \pm 0.05$
	20	$7.3^{c} \pm 0.07$	$5.34^{hi} \pm 0.03$	$8.04^{h} \pm 0.04$	$7.46^{ij} \pm 0.06$
	30	$7.5^{c} \pm 0.04$	$5.57^{i} \pm 0.01$	$8.2^{i} \pm 0.01$	$7.54^{j} \pm 0.04$
Fish Roll 4	Days	pH	FFA	PV	TMA
	0	$7.0^{d} \pm 0.01$	$3.66^{j} \pm 0.02$	$4.05^{j} \pm 0.04$	$4.56^{k} \pm 0.03$
	10	$7.15^{d} \pm 0.07$	$4.03^{jk} \pm 0.04$	$4.56^{k} \pm 0.09$	$6.59^{l} \pm 0.03$
	20	$7.5^{d} \pm 0.07$	$4.23^{k} \pm 0.03$	$7.49^{kl} \pm 0.01$	$7.33^{m} \pm 0.04$
	30	$7.8^{d} \pm 0.04$	$5.11^{l} \pm 0.01$	$7.53^{l} \pm 0.09$	$7.87^{n} \pm 0.04$
Fish Roll 5	Days	pH	FFA	PV	TMA
	0	$6.8^{e} \pm 0.07$	$5.08^{m} \pm 0.06$	$8.53^{m} \pm 0.01$	$6.02^{o} \pm 0.03$
	10	$7.1^{e} \pm 0.02$	$5.6^{n} \pm 0.07$	$9.15^{mn} \pm 0.21$	$6.95^{p} \pm 0.07$
	20	$7.2^{e} \pm 0.02$	$6.05^{o} \pm 0.07$	$9.75^{n} \pm 0.07$	$7.43^{pq} \pm 0.01$
	30	$7.5^{e} \pm 0.07$	$6.4^{p} \pm 0.01$	$10.2^{o} \pm 0.03$	$9.15^{q} \pm 0.04$
Fish Roll 6	Days	pH	FFA	PV	TMA
	0	$6.5^{f} \pm 0.07$	$6.1^{q} \pm 0.02$	$8.05^{p} \pm 0.02$	$6.7^{r} \pm 0.03$
	10	$6.9^{f} \pm 0.03$	$6.42^{qr} \pm 0.01$	$8.63^{q} \pm 0.02$	$7.63^{rs} \pm 0.09$
	20	$7.1^{f} \pm 0.07$	$7.62^{r} \pm 0.02$	$9.01^{qr} \pm 0.01$	$7.85^{s} \pm 0.07$
	30	$7.3^{f} \pm 0.05$	$7.9^{s} \pm 0.04$	$10.35^{r} \pm 0.02$	$8.63^{t} \pm 0.01$

FR1=Fish Roll Sample 1, FR2= Fish Roll Sample 2, FR3=Fish Roll Sample 3, FR4= Fish Roll Sample 4, FR5= Fish Roll Sample 5, FR6= Fish Roll Sample 6

DISCUSSION

Changes in pH: The change in pH of fish muscle is usually a good index for quality assessment such as texture of fish (Rathod and Pagarkar, 2013).In the post mortem period, decomposition of nitrogenous compounds leads to an increase in pH in the fish flesh. In the present study, pH values of the fish roll samples ranged between 6.6 - 7.2(FR1), 6.2 - 7.5 (FR2), 6.8 -7.5(FR3), 7.0 - 7.8 (FR4),6.8-7.5(FR5) and 6.5 to 7.3(FR6) during the 30days storage in refrigerator at 4^{0}C. The fish roll samples showed increase in pH value with increased storage time.

The results obtained in this study are similar to Bett and Dionigi (1997) who reported that decomposition of nitrogenous components in postmortem period, causes increase in pH of fish flesh. Pawar (2011) also reported that the cutlets made from catla (*Catla catla)* fish, showed increasing trend of pH from 6.50 to 6.79 when stored at 2-4^{o}C. The increasing pH values could be associated with the production of basic components induced by the growth of bacteria (Simeonidou *et al*., 1998). It may also be attributed to the rapid spoilage of the fish product and the

formation of alkaline compounds (Atre *et al*., 2009). This increase in pH indicates the loss of quality (Shenderyuk and Bykowski, 1990).

Changes in peroxide value (PV): Peroxide value is a measure of the concentration of peroxide and hydroperoxide components formed during the initial stages of lipid oxidation. Peroxide values for the fish roll samples were found to be 8.78 -11.99meq of O_2 /kg (FR1), 7.69 - 9.16meq of O_2 /kg (FR2), 7.18 - 8.29meq of O_2 /kg (FR3), 4.05 - 7.53meq of O_2 /kg (FR4), 8.53 -10.29meq of O_2 /kg (FR5) and 8.05 - 10.35meq of O_2 /kg (FR6).A significant increase in the peroxide value of the fish roll samples($p<0.05$) was observed during frozen storage indicating a close relationship between development of rancidity and the time of frozen storage.

Increased PV content was also observed by other scientists during the frozen storage of fish burger produced from tilapia (Tokur *et al*., 2004); frozen storage of fish burgers where PV values rose from 14 to 23.7 meqO_2/kg of fat (Al-Bulushi *et al*., 2005) and frozen storage of fish cutlet (Ninan *et al*., 2010) where PV values increased to 12.88meqO_2/kg at the end of 12weeks.

The increase in the peroxide value of the fish rolls ($p<0.05$) during frozen storage with increasing storage time, may be to mechanical mincing of the fish meat. This could speed up oxidation due to the incorporation of oxygen in the tissue. High peroxide values are a definite measure of rancidity in fats. Slightly oxidized fat and oil having PV at levels of 100 meq kg-1 are reported to be neurotoxic. (Gotoh *et al*., 2006; Gotoh and Wadah 2006).Thus the refrigerated fish roll samples were still fit for consumption since they remained under limits for ediblilty.

Changes in free fatty acids (FFA): In this study, the fish roll samples had FFA values ranging from 4.09 – 6.97(FR1), 4.16-5.64 (FR2), 3.49 - 5.57(FR3), 3.66 - 5.11(FR4), 5.08 -6.4(FR5) and 6.13 - 7.9(FR6)which increased significantly ($P<0.05$) all through the refrigerated storage period. Free fatty acid content is an index of the extent to which hydrolytic rancidity has occurred in a product. Free fatty acid is a triacyl glyceride product formed by either chemical or enzyme mediated hydrolysis (Barthet *et al*., 2008).As the quality of freshness of fish reduces, the FFA content in the lipids of fish increases due to action of lipases (Reddy *et al*., 1992). While the formation of FFA itself does not lead to nutritional losses, its assessment is deemed important when considering rancidity development.

A significant increase in the FFA values was observed by Tukur *et al*., (2004) during the frozen storage of fish burger for 8 months. In the study carried out by Ninan *et al*. (2010), it was found that FFA concentration increased in fish cutlet prepared from tilapia minced meat stored at -20^{0}C. Since the release of FFA increased with time, as shown in this study, it has been reported that there is a relationship between FFA release and loss of freshness (Ozogul *et al*., 2005; Rodriguez *et al*., 2006).

Changes in Trimethylamine (TMA): Trimethylamine (TMA) is produced by the decomposition of trimethylamine N-oxidase caused by bacteria spoilage and enzymatic activity. Acceptable TMA value for fish is stated as 5-10mg/100g (Huidobro *et al*., 2002:Taskaya *et al*., 2003).Changes in trimethylamine values of fish roll samples are shown in Table 1.TMA values for the fish products ranged between 6.41 - 7.85(FR1), 6.57 - 7.05(FR2), 6.4 - 7.54(FR3), 4.56 - 7.87(FR4), 6.02 - 9.15(FR5) and 6.7 - 8.63(FR6).TMA values of fish roll samples stored in refrigerated storage increased with time but remained within acceptable limit. Thus they were still fit for consumption by the 30th day of refrigerated storage.

CONCLUSION

This paper examined quality changes in commercially sold ready-to-eat fish roll samples, during refrigerated storage at 4^{o}C, based on the evaluation of some biochemical parameters (pH, PV, FFA and TMA).The rate of quality deterioration was an accelerated process with the passage of storage time. Results of biochemical analyses indicated that the fish roll samples were still fit for consumption at the end of the experiment.

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